



**THE DATASHEET OF
MRF21010LSR1**



RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

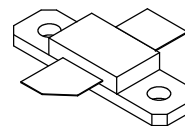
- Typical W-CDMA Performance: -45 dBc ACPR, 2140 MHz, 28 Volts, 5 MHz Offset/4.096 MHz BW, 15 DTCH
 Output Power — 2.1 Watts
 Power Gain — 13.5 dB
 Efficiency — 21%
- Capable of Handling 10:1 VSWR @ 28 Vdc, 2140 MHz, 10 Watts CW Output Power

Features

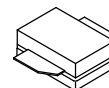
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.
- RoHS Compliant.
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 Inch Reel.

MRF21010LR1
MRF21010LSR1

2110-2170 MHz, 10 W, 28 V
LATERAL N-CHANNEL
BROADBAND
RF POWER MOSFETs



CASE 360B-05, STYLE 1
NI-360
MRF21010LR1



CASE 360C-05, STYLE 1
NI-360S
MRF21010LSR1

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Table 1. Maximum Ratings

| Rating | Symbol | Value | Unit |
|---|------------------|---------------|-----------|
| Drain-Source Voltage | V _{DSS} | -0.5, +65 | Vdc |
| Gate-Source Voltage | V _{GS} | - 0.5, +15 | Vdc |
| Total Device Dissipation @ T _C = 25°C Derate above 25°C | P _D | 43.75 0.25 | W W/°C |
| Storage Temperature Range | T _{stg} | - 65 to +150 | °C |
| Case Operating Temperature | T _C | 150 | °C |
| Operating Junction Temperature | T _J | 200 | °C |

Table 2. Thermal Characteristics

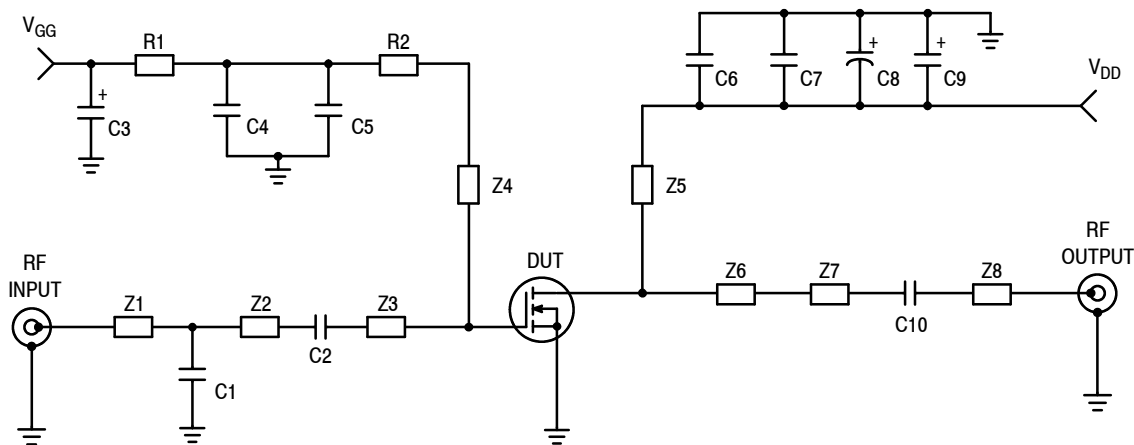
| Characteristic | Symbol | Value | Unit |
|--------------------------------------|------------------|-------|------|
| Thermal Resistance, Junction to Case | R _{θJC} | 5.5 | °C/W |

Table 3. ESD Protection Characteristics

| Test Conditions | Class |
|------------------|--------------|
| Human Body Model | 1 (Minimum) |
| Machine Model | M1 (Minimum) |

Table 4. Electrical Characteristics ($T_C = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---------------|-----|------|-----|-----------------|
| Off Characteristics | | | | | |
| Drain-Source Breakdown Voltage ($V_{GS} = 0\text{ Vdc}$, $I_D = 10\ \mu\text{A}$) | $V_{(BR)DSS}$ | 65 | — | — | Vdc |
| Zero Gate Voltage Drain Current ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$) | I_{DSS} | — | — | 10 | μAdc |
| Gate-Source Leakage Current ($V_{GS} = 5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$) | I_{GSS} | — | — | 1 | μAdc |
| On Characteristics | | | | | |
| Gate Threshold Voltage ($V_{DS} = 10\text{ V}$, $I_D = 50\ \mu\text{A}$) | $V_{GS(th)}$ | 2.5 | 3 | 4 | Vdc |
| Gate Quiescent Voltage ($V_{DS} = 28\text{ V}$, $I_D = 100\text{ mA}$) | $V_{GS(Q)}$ | 2.5 | 4 | 4.5 | Vdc |
| Drain-Source On-Voltage ($V_{GS} = 10\text{ V}$, $I_D = 0.5\text{ A}$) | $V_{DS(on)}$ | — | 0.4 | 0.5 | Vdc |
| Forward Transconductance ($V_{DS} = 10\text{ V}$, $I_D = 1\text{ A}$) | g_{fs} | — | 0.95 | — | S |
| Dynamic Characteristics | | | | | |
| Reverse Transfer Capacitance ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0$, $f = 1\text{ MHz}$) | C_{rss} | — | 1 | — | pF |
| Functional Tests (In Freescale Test Fixture, 50 ohm system) | | | | | |
| Two-Tone Common Source Amplifier Power Gain ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 10\text{ W PEP}$, $I_{DQ} = 100\text{ mA}$, $f_1 = 2110\text{ MHz}$, $f_2 = 2170\text{ MHz}$, Tone Spacing = 100 KHz) | G_{ps} | 12 | 13.5 | — | dB |
| Two-Tone Drain Efficiency ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 10\text{ W PEP}$, $I_{DQ} = 100\text{ mA}$, $f_1 = 2110\text{ MHz}$, $f_2 = 2170\text{ MHz}$, Tone Spacing = 100 KHz) | η | 31 | 35 | — | % |
| Third Order Intermodulation Distortion ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 10\text{ W PEP}$, $I_{DQ} = 100\text{ mA}$, $f_1 = 2110\text{ MHz}$, $f_2 = 2170\text{ MHz}$, Tone Spacing = 100 KHz) | IMD | — | -35 | -30 | dBc |
| Input Return Loss ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 10\text{ W PEP}$, $I_{DQ} = 100\text{ mA}$, $f_1 = 2110\text{ MHz}$, $f_2 = 2170\text{ MHz}$, Tone Spacing = 100 KHz) | IRL | — | -12 | -10 | dB |
| Output Power, 1 dB Compression Point, CW ($V_{DD} = 28\text{ Vdc}$, $I_{DQ} = 100\text{ mA}$, $f = 2170\text{ MHz}$) | P1dB | — | 11 | — | W |
| Common-Source Amplifier Power Gain ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 10\text{ W CW}$, $I_{DQ} = 100\text{ mA}$, $f = 2170\text{ MHz}$) | G_{ps} | — | 12 | — | dB |
| Drain Efficiency ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 10\text{ W CW}$, $I_{DQ} = 100\text{ mA}$, $f = 2170\text{ MHz}$) | η | — | 42 | — | % |



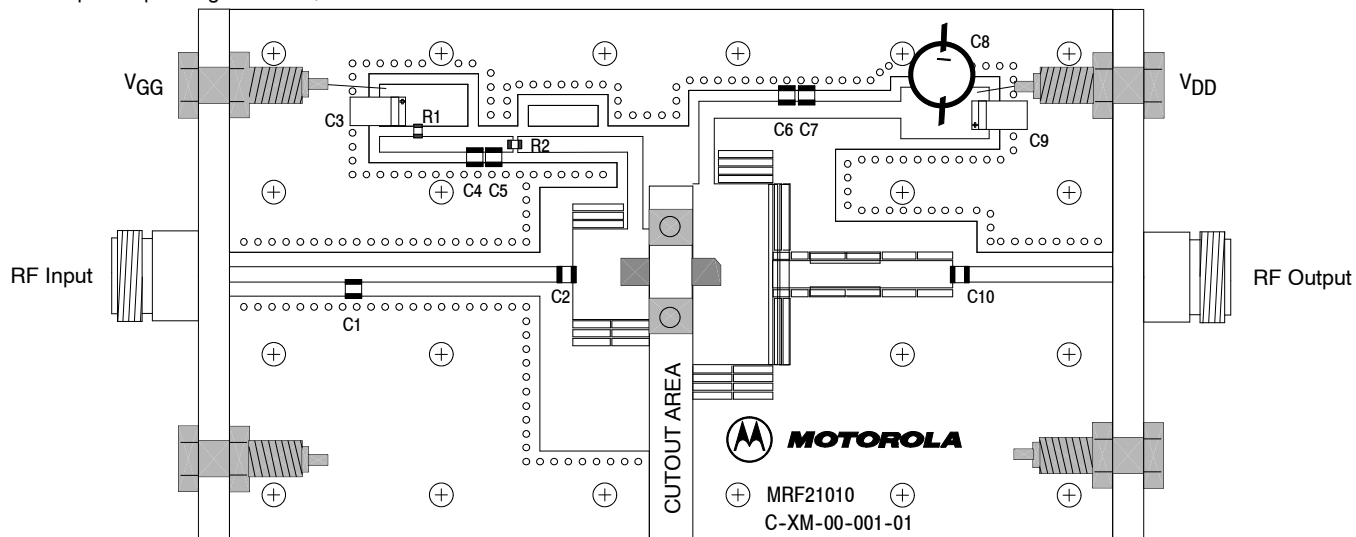
| | | | |
|----|----------------------------|-----|---|
| Z1 | 0.964" x 0.087" Microstrip | Z6 | 0.453" x 1.118" Microstrip |
| Z2 | 0.905" x 0.087" Microstrip | Z7 | 0.921" x 0.154" Microstrip |
| Z3 | 0.433" x 0.512" Microstrip | Z8 | 0.925" x 0.087" Microstrip |
| Z4 | 1.068" x 0.087" Microstrip | PCB | Taconic TLX8-0300, 0.030", $\epsilon_r = 2.55$ |
| Z5 | 0.752" x 0.087" Microstrip | | |

Figure 1. MRF21010L Test Circuit Schematic

Table 5. MRF21010L Test Circuit Component Designations and Values

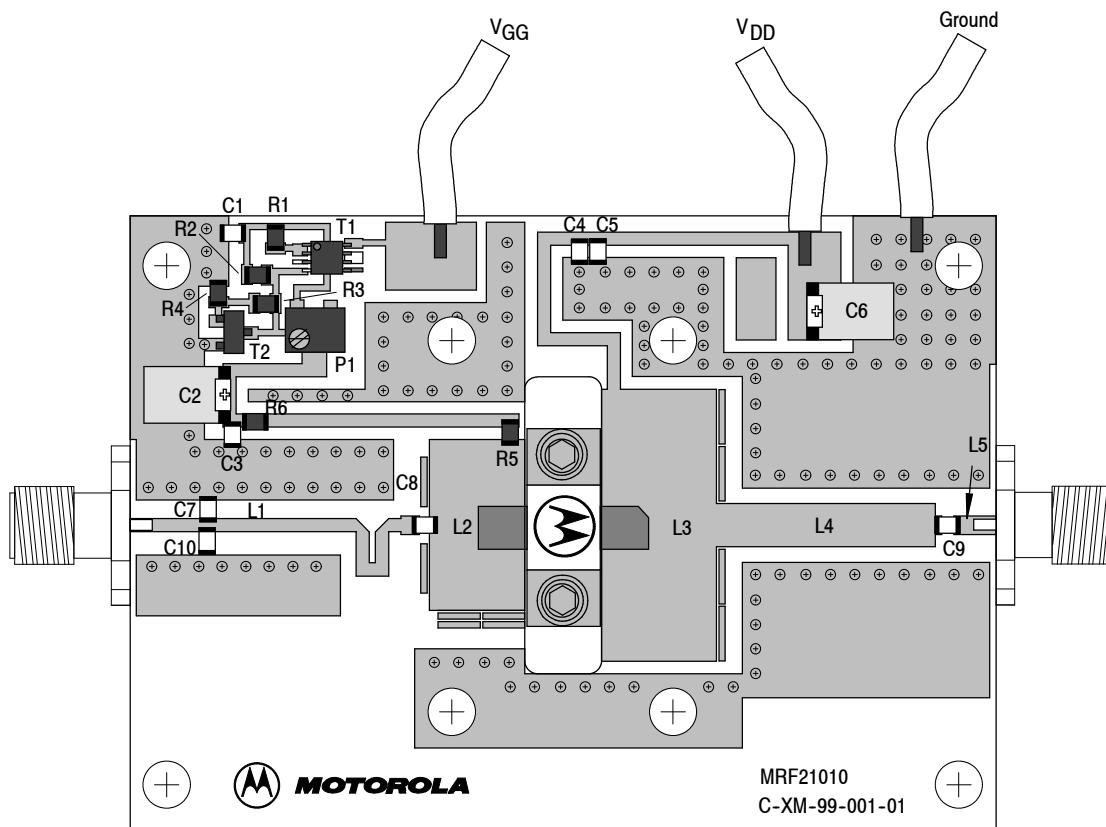
| Part | Description | Part Number | Manufacturer |
|--------|---|-----------------|----------------|
| C1 * | 2.2 pF Chip Capacitor | 100B2R2BW | ATC |
| | (eared) | | |
| | 1.8 pF Chip Capacitor | 100B1R8BW | ATC |
| | (earless) | | |
| C2 | 0.5 pF Chip Capacitor | 100B0R5BW | ATC |
| C3, C9 | 10 μ F, 35 V Tantalum Chip Capacitors | 293D106X9035D2T | Sprague-Vishay |
| C4, C7 | 1 nF Chip Capacitors | 100B102JW | ATC |
| C5, C6 | 5.6 pF Chip Capacitors | 100B5R6BW | ATC |
| C8 | 470 μ F, 63 V Electrolytic Capacitor | | |
| C10 | 10 pF Chip Capacitor | 100B100GW | ATC |
| N1, N2 | Type N Connector Flange Mounts | 3052-1648-10 | Macom |
| R1 | 1.0 k Ω Chip Resistor (0805) | | |
| R2 | 12 Ω Chip Resistor (0805) | | |

* Piece part depending on eared / earless version of the device.



Freescle has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescle Semiconductor signature/logo. PCBs may have either Motorola or Freescle markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 2. MRF21010L Test Circuit Component Layout



Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 3. MRF21010L Demonstration Board Component Layout

Table 6. MRF21010L Demonstration Board Component Designations and Values

| Designators | Description |
|-------------|---|
| C1 | 1 μ F Chip Capacitor (0805), AVX #08053G105ZATEA |
| C2, C6 | 10 μ F, 35 V Tantalum Capacitors, Vishay-Sprague #293D106X9035D |
| C3, C4 | 6.8 pF Chip Capacitors, ACCU-P (0805), AVX #08051J6R8CBT |
| C5 | 10 nF Chip Capacitor (0805), AVX #08055C103KATDA |
| C7 | 1.5 pF Chip Capacitor, ACCU-P (0805), AVX #08051J2R2BBT |
| C8, C10 | 0.5 pF Chip Capacitors, ACCU-P (0805), AVX #08051J0R5BBT |
| C9 | 10 pF Chip Capacitor, ACCU-P (0805), AVX #08055J100GBT |
| L1 | 19 mm \times 1.07 mm |
| L2 | 7.7 mm \times 13.8 mm |
| L3 | 9.3 mm \times 22 mm |
| L4 | 17.7 mm \times 3.5 mm |
| L5 | 3.4 mm \times 1.5 mm |
| R1, R6 | 10 Ω , 1/8 W Chip Resistors (0805) |
| R2, R3 | 1 k Ω , 1/8 W Chip Resistors (0805) |
| R4 | 2.2 k Ω , 1/8 W Chip Resistor (0805) |
| R5 | 0 Ω , 1/8 W Chip Resistor (0805) |
| P1 | 5 k Ω Potentiometer CMS Cermet Multi-Turn, Bourns #3224W |
| T1 | Voltage Regulator, Micro-8, #LP2951 |
| T2 | Bipolar NPN Transistor, SOT-23, #BC847 |
| PCB | Rogers RO4350, 0.5 mm, $\epsilon_r = 3.53$ |

TYPICAL CHARACTERISTICS

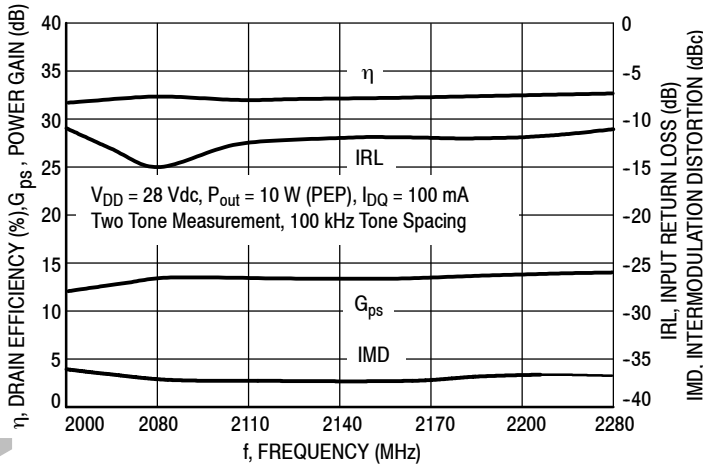


Figure 4. Class AB Broadband Circuit Performance

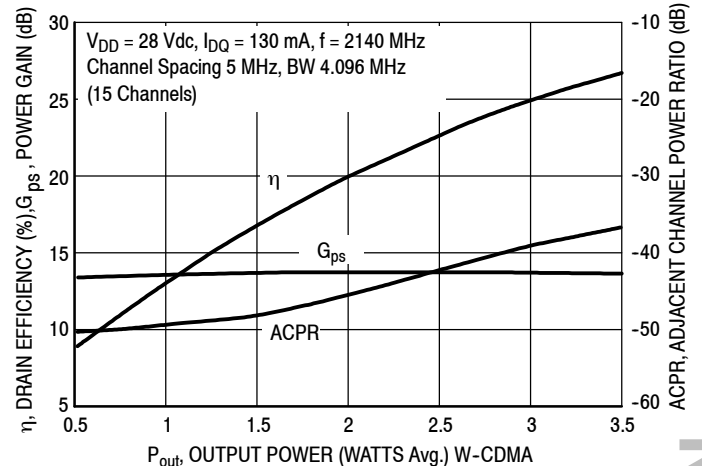


Figure 5. W-CDMA ACPR, Power Gain and Drain Efficiency versus Output Power

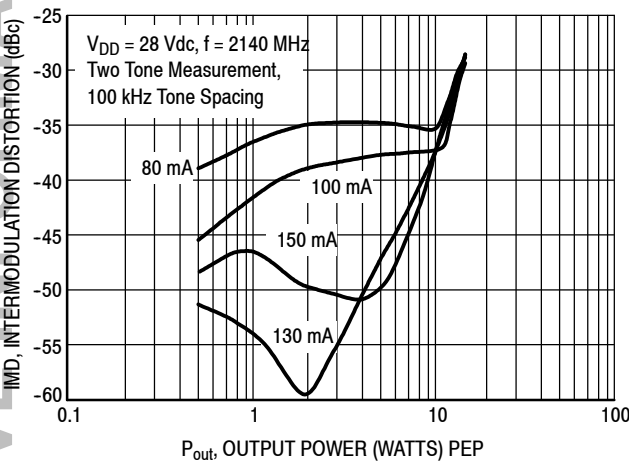


Figure 6. Intermodulation Distortion versus Output Power

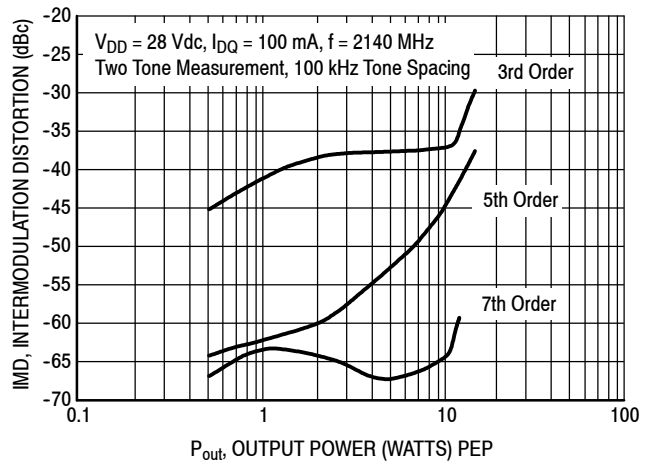


Figure 7. Intermodulation Distortion Products versus Output Power

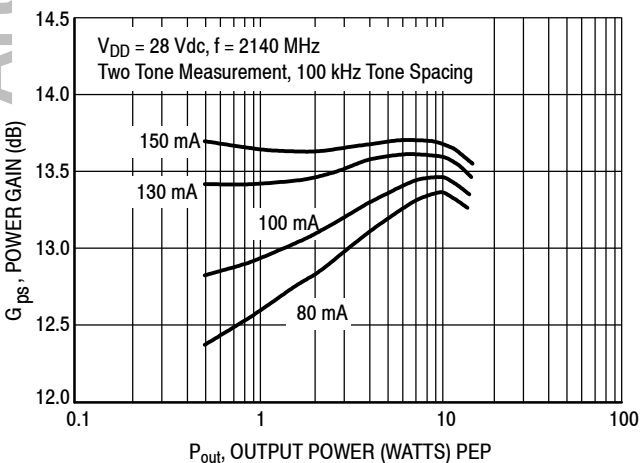


Figure 8. Power Gain versus Output Power

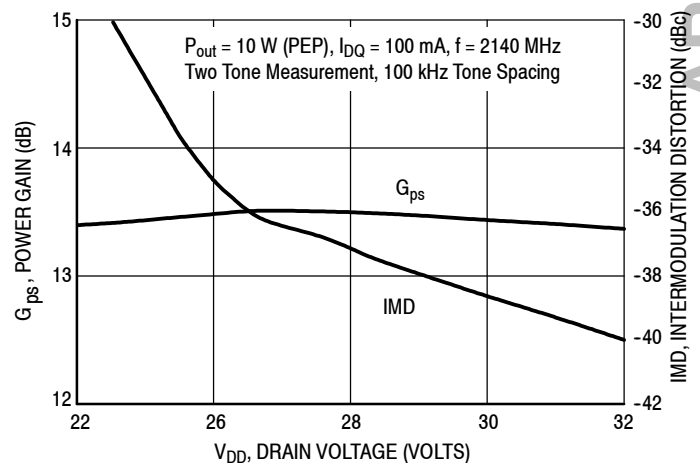
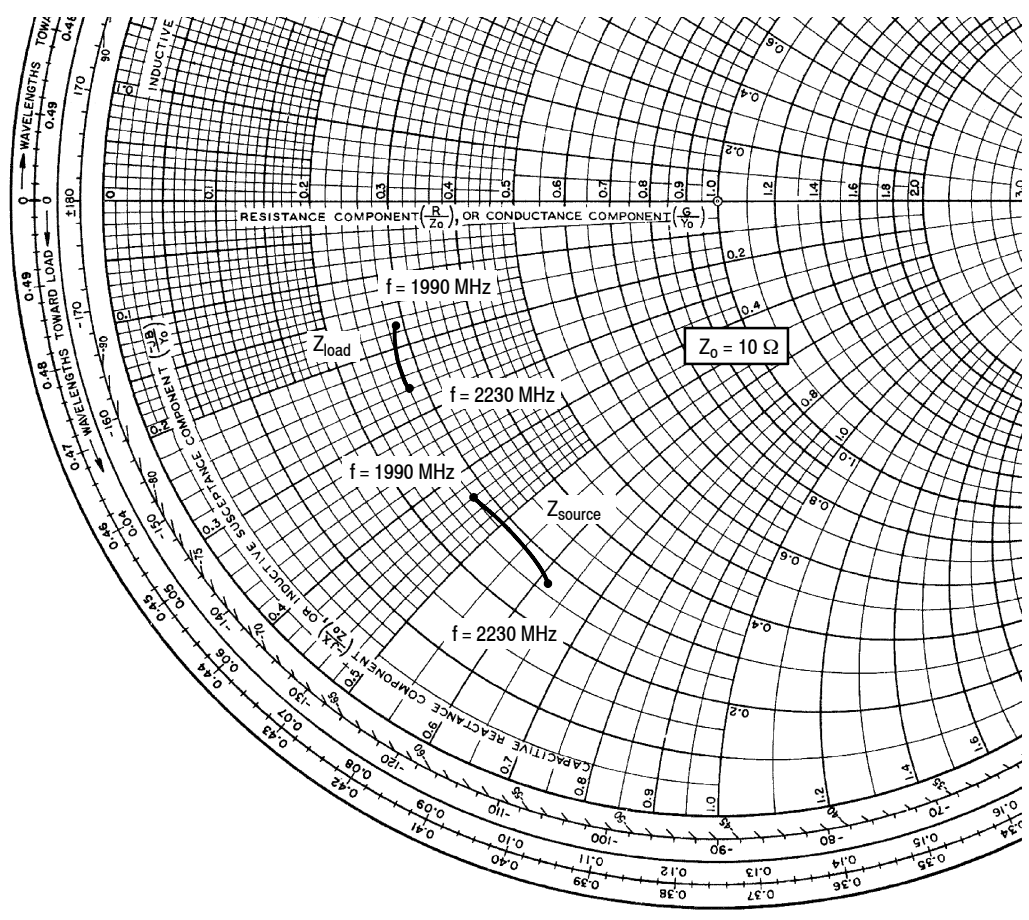


Figure 9. Intermodulation and Gain versus Supply Voltage

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$V_{DD} = 28\text{ V}$, $I_{DQ} = 100\text{ mA}$, $P_{out} = 10\text{ W PEP}$

| f MHz | Z_{source} Ω | Z_{load} Ω |
|----------|--------------------------|------------------------|
| 1990 | $2.85 - j4.38$ | $2.93 - j1.71$ |
| 2110 | $2.89 - j5.04$ | $2.76 - j2.28$ |
| 2230 | $2.73 - j6.19$ | $2.83 - j2.59$ |

Z_{source} = Test circuit impedance as measured from gate to ground.

Z_{load} = Test circuit impedance as measured from drain to ground.

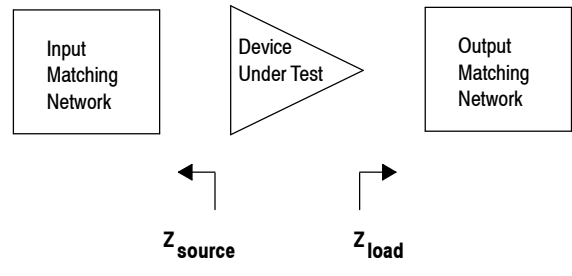
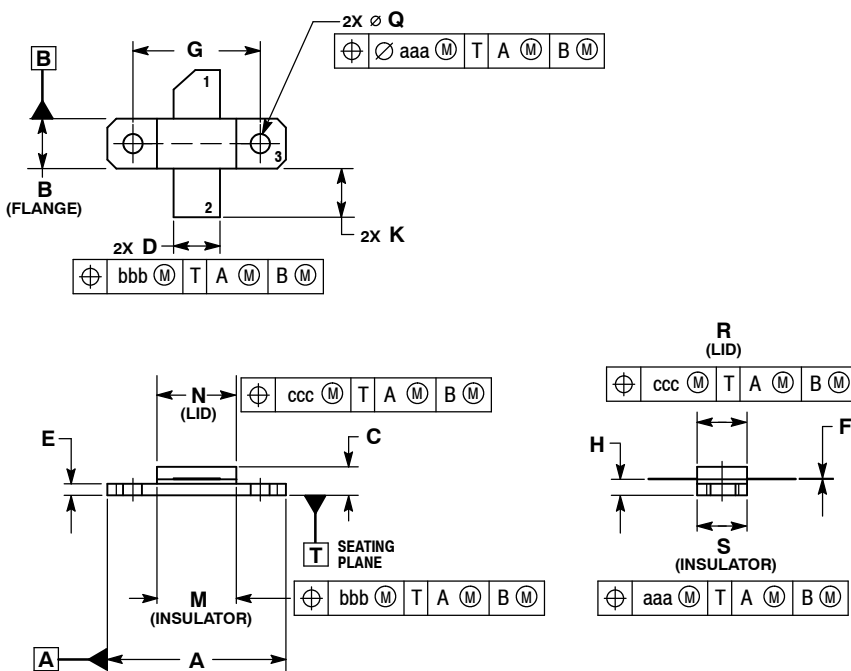


Figure 10. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS

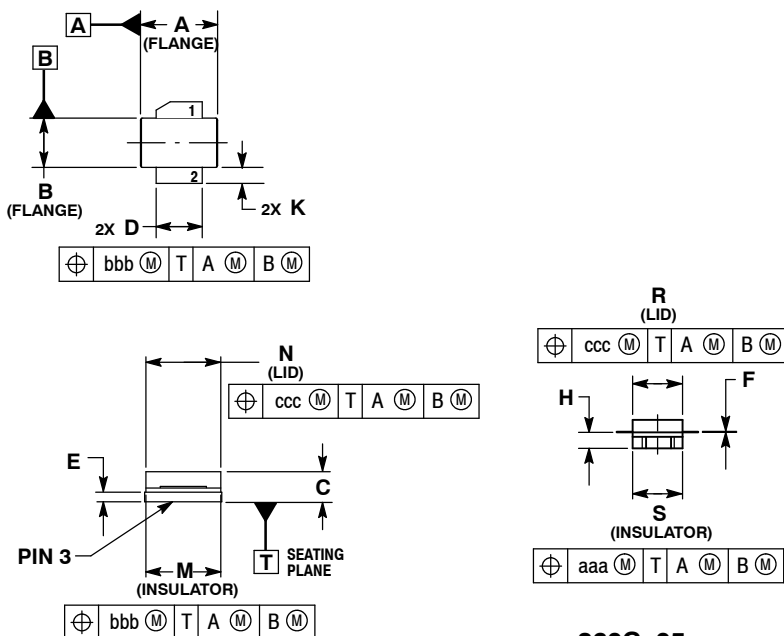


- NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.795 | 0.805 | 20.19 | 20.45 |
| B | 0.225 | 0.235 | 5.72 | 5.97 |
| C | 0.125 | 0.175 | 3.18 | 4.45 |
| D | 0.210 | 0.220 | 5.33 | 5.59 |
| E | 0.055 | 0.065 | 1.40 | 1.65 |
| F | 0.004 | 0.006 | 0.10 | 0.15 |
| G | 0.562 BSC | | 14.28 BSC | |
| H | 0.077 | 0.087 | 1.96 | 2.21 |
| K | 0.220 | 0.250 | 5.59 | 6.35 |
| M | 0.355 | 0.365 | 9.02 | 9.27 |
| N | 0.357 | 0.363 | 9.07 | 9.22 |
| Q | 0.125 | 0.135 | 3.18 | 3.43 |
| R | 0.227 | 0.233 | 5.77 | 5.92 |
| S | 0.225 | 0.235 | 5.72 | 5.97 |
| aaa | 0.005 REF | | 0.13 REF | |
| bbb | 0.010 REF | | 0.25 REF | |
| ccc | 0.015 REF | | 0.38 REF | |

- STYLE 1:
 PIN 1. DRAIN
 2. GATE
 3. SOURCE

CASE 360B-05
ISSUE G
NI-360
MRF2101LR1



- NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
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 3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.375 | 0.385 | 9.53 | 9.78 |
| B | 0.225 | 0.235 | 5.72 | 5.97 |
| C | 0.105 | 0.155 | 2.67 | 3.94 |
| D | 0.210 | 0.220 | 5.33 | 5.59 |
| E | 0.035 | 0.045 | 0.89 | 1.14 |
| F | 0.004 | 0.006 | 0.10 | 0.15 |
| H | 0.057 | 0.067 | 1.45 | 1.70 |
| K | 0.085 | 0.115 | 2.16 | 2.92 |
| M | 0.355 | 0.365 | 9.02 | 9.27 |
| N | 0.357 | 0.363 | 9.07 | 9.22 |
| R | 0.227 | 0.23 | 5.77 | 5.92 |
| S | 0.225 | 0.235 | 5.72 | 5.97 |
| aaa | 0.005 REF | | 0.13 REF | |
| bbb | 0.010 REF | | 0.25 REF | |
| ccc | 0.015 REF | | 0.38 REF | |

- STYLE 1:
 PIN 1. DRAIN
 2. GATE
 3. SOURCE

360C-05
ISSUE E
NI-360S
MRF2101LSR1

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